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THE HOME PRODUCTION OF ONION SEED AND SETS.

BY

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., January 12, 1911.

SIR: I have the honor to transmit herewith a manuscript entitled "The Home Production of Onion Seed and Sets," by Mr. W. R. Beattie, Assistant Horticulturist, and to recommend that it be published as a Farmers' Bulletin.

The production of onion seed and sets is of considerable importance from both a truck-crop and farm standpoint. As the handling of these crops requires a knowledge of special methods of culture there is a constant demand for the information herein contained.

Respectfully,

WM. A. TAYLOR,
Acting Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

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THE HOME PRODUCTION OF ONION SEED AND SETS.¹

INTRODUCTION.

Many of the leading onion growers of the Northern States are now raising their own supplies of seed, for by so doing they can procure a better grade than is obtainable in the general market. During the early history of onion-seed growing in this country the crop was practically all produced in small plantings. Later the production of seed fell into the hands of a few large or speculative growers. During recent years there has been a tendency to return to former conditions.

Formerly the supply of onion seed came from farmers who selected seed bulbs of a uniform type year after year and in so doing established a definite strain; these bulbs were chosen from the entire crop of marketable onions, which permitted the selection of only those of the type desired for seed. In so doing the farmers were practicing selection, all bulbs not conforming to the desired type being discarded. In commercial onion-seed growing, where the bulbs are grown exclusively for seed purposes, it would not be profitable to discard all those that do not conform to the desired type.

It is customary for growers to select very carefully the few mother bulbs necessary to produce stock seed from which to grow their commercial crop of seed. In cases where commercial seed growers are short of bulbs for seed purposes, they frequently go into the market and purchase the best obtainable to make up the deficiency. Where a farmer is producing three or four thousand bushels of onions for the market from pedigree seed, it will be a comparatively easy matter for him to select two or three hundred bushels of extra fine bulbs of the type desired for seed. Onion seed produced in this

¹ For the culture of onions for the general market, see Farmers' Bulletin No. 354, entitled "Onion Culture," which will be sent free on application to the Secretary of Agriculture.

manner from selected bulbs and sold at \$1.50 a pound will in the end be cheaper than seed at 40 cents a pound that has come from a miscellaneous lot of bulbs taken as they run, without selection.

Unfortunately, the home production of onion seed is now more or less dependent upon the market price of onions the previous season. Many growers plant for seed only when they have failed to sell their crop, thus giving uncertainty and irregularity to the enterprise. There are a few farmers who plant a fairly uniform quantity of bulbs for seed each year, and who are making a decided success of the work.

Certain growers are better equipped than are others for the growing and handling of the seed, and thus are in position to supply seed for the entire community. It has been found that carefully grown seed planted in the same general locality in which it is produced will give better results than seed brought from a distance; this is especially true in northern localities, where the season of growth is short, as southern-grown seed requires a longer season for its maturity.

The production of onion sets has been confined to a few localities. Now, however, the industry is receiving more general attention. Sets may be produced under a reasonably wide range of conditions, but in order to be successful it is essential that the grower should fully understand the principles and methods involved. The production of onion seed and sets is an important phase of the general onion industry, but owing to its more local nature it is treated separately.

HOME PRODUCTION OF ONION SEED.

SELECTION AND CARE OF BULBS FOR SEED.

The bulbs, or "mother bulbs," as they are commonly called, for the production of onion seed should be grown in the same manner as those intended for marketing, except that more care should be taken throughout. Some seed growers prefer to use 6 pounds of seed to an acre for the production of seed bulbs instead of 4 pounds, as ordinarily used in growing for market, in order that the bulbs may crowd and not become too large. The planting, culture, and harvesting of the bulbs are practically the same as for first-class marketable stock.

Onion-seed growing is a two-year process and two crops are constantly to be cared for. After growing the bulbs the first summer they must be stored over winter and replanted the following spring for the production of seed. Meantime the crop for the next year's planting must be coming on in order to have a crop of seed every year.

Onion seed can not be grown profitably in all parts of the country, for various reasons. Proper soil conditions are essential; also a climate that is free from extremes of temperature and rainfall. Cer-

tain localities in the Northeastern States near the ocean, around the Great Lakes, and again on the Pacific coast are especially adapted to the production of onion seed.

The first requisite for the growing of the best seed is a clear-cut ideal of the exact shape, form, color, and general characteristics sought in the variety being grown. The second requisite is the growing of seed from bulbs of that exact type for the greatest possible number of generations.

Two selections should be made, the first to include but a small number of the very finest and most ideal bulbs from which to produce the stock seed to be used the following year for the growing of the seed bulbs, and the second to include the bulbs from which to grow the supply of seed for the market. By keeping the very best stock separate and using the product for propagation the entire strain will be gradually improved. Bulbs a trifle below the ideal market size, or about $1\frac{1}{2}$ to 2 inches in diameter, are the most profitable for seed production.

CARE OF BULBS DURING WINTER.

Bulbs that are to be used for seed production should be allowed to become thoroughly ripe in the field. After pulling they should be stored in crates under a roof where they will have plenty of ventilation and be protected from sun and rain. Before freezing weather begins the onions should be graded and removed to a house where both ventilation and temperature can be controlled.

The temperature of the storage house should at no time be so low as to cause the bulbs to become frosted. A temperature of 32° F. for a short period will do no harm, but should not be allowed to continue. If the bulbs become frosted, heated, or sweated in storage they will sprout before planting time and be greatly injured for seed purposes. In general, the storage conditions should be the same as for marketable onions.

SOILS ADAPTED TO THE GROWING OF ONION SEED.

Two types of soil may be used to advantage in growing onion seed. The soil upon which the bulbs are grown from seed should be quite rich and well supplied with organic matter and moisture. Good, rich, sandy loam is best adapted to the growing of the bulbs. For the production of seed from bulbs a soil that is well drained, fertile, and of a loamy nature is desirable. It is customary to grow the bulbs the first season on rich bottom land and to grow the seed the second season on well-drained upland. Soils containing an abundance of lime, such as are suited to the successful production of wheat, are adapted to onion-seed growing. The soil should be free from weed seeds and in a good state of tilth.

The bulbs for seed growing should not be set in a soil containing large quantities of fresh stable manure or green vegetable matter, but rather in a soil where some cultivated crop, such as corn, has been grown the previous season. Commercial fertilizers containing a small percentage of nitrogen, 6 to 8 per cent of available phosphoric acid, and 6 to 8 per cent of potash can be used to advantage at a rate not exceeding 1,000 pounds to the acre.

PREPARATION OF THE SOIL AND PLANTING.

In preparing the land for setting the bulbs apply the fertilizer and reduce the soil to a good state of tilth. Then mark off the land in rows about $2\frac{1}{2}$ to $3\frac{1}{2}$ feet apart by means of a one-horse plow, a



FIG. 1.—Method of setting out bulbs for seed production.

corn marker, or some tool that will leave a decided furrow in which to set the bulbs. In some sections the rows are placed as close as 2 feet, but this hinders cultivation.

The bulbs should be placed by hand (fig. 1), root downward, from 3 to 6 inches apart, center to center, in the furrow. The usual rule is to so set the bulbs that the distance between them will be about equal to the diameter of the bulbs. The quantity of bulbs that may be set on an acre will depend largely upon their size, but may be as high as 250 bushels. Where the seed is to be employed for growing sets and overgrown sets are used as "mother" bulbs the quantity required may be as low as 50 bushels to the acre. The

bulbs should be placed in the ground sufficiently deep to be entirely below the surface of the soil when covered. As growth proceeds, the soil should be drawn around the bulbs to form a support for the seed stalks.

CULTIVATION.

Shallow cultivation should be given throughout, the object being to keep the land free from weeds and the soil worked toward the plants. Very little handwork will be necessary except, perhaps, to go through after the seed heads have formed, remove the weeds, and draw the soil around the plants to hold the stalks erect and prevent the seed heads from blowing down and coming in contact with the soil.



FIG. 2.—Field of onion seed a short time before harvesting.

TIME AND MANNER OF GATHERING THE SEED.

The proper time to gather the seed is when the inside of the grain has reached the dough stage. Onion seed assumes its black color very early; in fact, before it has passed the watery stage and formed milk in the grain. This change of color is no indication of ripeness and very often deceives the inexperienced grower. The heads should be harvested just before the first-formed seed begins to shatter in handling.

Figure 2 shows a field of onions a short time before the seed is ripe. In harvesting, the heads are cut by hand, with 2 to 6 inches of the stem attached, and are placed in bags for transportation to the curing sheds.

CURING THE SEED HEADS.

Any building having a tight floor and in which a free circulation of air can be maintained will serve as a curing place for onion seed. Many growers employ buildings similar to those used for curing tobacco, with the alternate vertical siding boards hinged so that they can be thrown open during good weather. In localities where rains do not occur during the curing period the seed heads are frequently dried on sheets of canvas stretched over frames or spread upon the ground.

For curing the seed in houses, wire-bottomed racks or trays placed one above the other are generally employed. As the seed is stirred from time to time during the curing process considerable of it will be shattered and fall upon the tray below or finally upon the floor. The main essentials in the curing of onion seed are to spread the heads very thinly, not over two heads in depth, and to give free ventilation. Even at a depth of 3 inches in the trays it will be necessary to stir them very often, especially during damp weather.

THRASHING AND CLEANING THE SEED.

The date for gathering the seed depends upon the locality and climate, but as a rule this will be about midsummer or not later than August 15. The thrashing and cleaning of the seed are often deferred until quite late in the autumn, except where the curing is done in the open air. Where large quantities of seed are produced the thrashing is done with machines similar to regular grain thrashers, but when grown on a small scale the seed is removed by beating with a flail.

After the seed has been thrashed, there is still considerable danger of its heating or molding if left in too great bulk. The usual practice is to run it through a fanning mill to remove the dust and small particles of the heads or chaff that are broken up in thrashing. In former years the method of cleaning was to place the seed in a tank of water, the heavy seed settling to the bottom of the tank, while the chaff and lighter portions could be floated off. This process is no longer used to any great extent, owing to the improvement in cleaning machinery, and the danger of injuring the seed by the water. After the seed is fanned and most of the foreign matter removed, it should be spread thinly on the floor or canvas and stirred from time to time. About the only test that can be applied in order to detect moisture in the seed is that of feeling it with the hand, and anyone experi-

enced in the handling of seed will soon become expert at determining when it is safe to bag it ready for storage or shipment.

YIELD OF ONION SEED TO AN ACRE.

The quantity of onion seed that can be grown on an acre depends on several conditions. In the first place this will be determined largely by the size of the bulbs that are planted. In the onion-set districts, where the seed with which to produce the sets is locally grown from overgrown sets, the quantity of seed is generally from 10 to 12 pounds to the bushel of bulbs planted. This seed, however, is not suitable for the production of standard market onions, and can be used for set growing only. In the production of seed from standard mother bulbs the yield is generally from 3 to 4 pounds of seed for every bushel of bulbs planted. This has been much higher in many cases, but $3\frac{1}{2}$ pounds is generally considered satisfactory. The yield of seed as a rule will be about 400 pounds to the acre, although as high as 800 or even 1,000 pounds have been secured.

The price per pound paid for the seed varies according to the quality, variety, and market demands. For first-class high-grade seed from specially selected bulbs of desirable types the growers frequently receive as much as \$1.25 a pound, but for the general crop produced from bulbs not specially selected, which must be sold in competition with the great mass of seed produced by large growers, the price is generally not more than 40 or 50 cents a pound.

When the cost of growing the bulbs, together with the preparation of the land, the keeping of the bulbs over winter, the necessity of handling them a large number of times, and the occupying of the land for two seasons, is considered, it will be readily seen there is not a great profit in growing onion seed. However, there are quite a number of farmers who each year plant 2 or 3 acres to bulbs for seed, and have for sale anywhere from 1,000 to 1,500 pounds of very choice seed. In many cases this represents the money crop of the farm. The extent to which this enterprise could be conducted with profit is doubtless limited, but the demand for high-grade seed of a distinct type is increasing each year. Anyone contemplating the growing of onion seed should carefully study local conditions, and then operate in a small way until the necessary practices are understood.

PRODUCTION OF SEED FOR ONION-SET GROWING.

Frequently the seed for onion-set growing is produced from bulbs selected from the sets themselves; in other words, the bulbs or mother bulbs are the overgrown sets. Near Louisville, Ky., the onion-set growers select the oversized bulbs and store them over winter. In

the spring they send them to farmers in the hill country and have their supply of seed grown on bluegrass land which has not been heavily manured. In this way they are able to keep their onion seed free from disease and secure a higher vitality than if the seed were grown on the same land where the bulbs were produced.

Owing to the great quantity of seed employed in set growing it is desirable to secure it cheaply, and the bulbs selected from the sets, being small, will produce a larger quantity of seed per bushel from mother bulbs than when grown in the usual manner. The stock seed bulbs should, however, be well matured, small necked, uniform in size, and selected according to an ideal shape. Onion seed from undersized bulbs is not so desirable, even for set growing, as that from standard bulbs.

After a crop of onion seed has been gathered it is the usual custom to plow up the bulbs and devote the land to some other crop. If the old bulbs are allowed to remain in the soil through the winter, especially if given slight protection, they will produce a small crop of seed the second season. This practice is not recommended except under special conditions where the land is not valuable or where it is particularly desirable to secure an additional quantity of seed from the bulbs.

CARE OF ONION SEED.

The length of time that onion seed will retain its vitality depends largely upon maturity and climatic conditions. Well-matured seed will always keep better than poorly ripened and inferior seed. Under ordinary conditions onion seed loses its vitality very rapidly after the second year, especially if stored in a damp climate. It will often pay to ship the seed to a dry climate for storage.

PRODUCTION OF ONION SETS.

CLIMATE AND SOILS ADAPTED TO ONION-SET GROWING.

The term "set," as applied to the onion, indicates a small, undersized bulb which, when replanted in the ground, will produce a large onion. This method of producing onions is perhaps the oldest and now the most universally employed for the growing of small areas of onions in the garden and where an early crop is desired. The common method of producing sets is to plant a large quantity of seed on a small area of rather rich land and thus procure a great number of bulbs that are undersized, owing to crowding and lack of plant food. The greater number of these bulbs do not attain sufficient size or maturity to produce seed the following season and are really plants in which the process of growth has been arrested.

In the United States the onion-set industry is largely confined to a few areas. The crop is extensively grown near Louisville, Ky.,

Chillicothe, Ohio, and Chicago, Ill., in the Platte River Valley of Nebraska, in southwestern New Jersey, and in southern California. The entire area devoted to this enterprise in these localities is estimated at from 2,500 to 3,000 acres. The yield to the acre varies with the locality, but will average about 300 bushels. The market for onion sets is found throughout the entire country, the greater portion being disposed of in small quantities.

The climatic conditions governing the production of onion sets are practically the same as those for standard onions, although it is not necessary to plant quite so early in the spring. Onion sets can undoubtedly be grown in any part of the Northern States where suitable soil conditions can be obtained. The soil adapted to onion-set culture is as a rule about the same as that required for the growing of large onions, except that the land should not be so rich.

In the Louisville district the soil is a clay loam, containing plenty of lime. This soil, by the use of fertilizer, will yield 250 to 350 bushels of mature unions and will produce an equal quantity of sets, but the fertilizer requirements for the latter are not so great. This land is underlain at a depth varying from 18 inches to 10 or 12 feet by limestone, and is a natural bluegrass soil, retentive of moisture, and comparatively free from weeds.

In the vicinity of Chillicothe, Ohio, the soil is a river-bottom loam, being principally the washings from the hills. This soil contains occasional small beds of gravel, but owing to its silty nature it is retentive of moisture and easily cultivated.

In the Chicago area we find a variation in soil texture. In the vicinity of South Chicago, the area devoted to onion-set growing was formerly a sewage-disposal farm and is laid off in regular level beds. This soil is of a sandy, loamy nature and is very similar to the river-bottom lands at Chillicothe. Northwest of Chicago the soil is a more gravelly loam, although in some places it is of a river-bottom or silty nature.

In southwestern New Jersey the soil is a sandy loam, not unlike the Norfolk sandy loam, although it contains more or less gravel, and in places the clay approaches the surface.

It will be seen that onion sets can be grown on any land that is adapted to general truck crops, the main essential being freedom from weeds and a reasonably high state of tillage.

PREPARATION OF THE SOIL.

In preparing the land for onion-set growing the work should be performed in practically the same manner as for regular crops of onions. The plowing need be only moderately deep, but the soil must be brought to a smooth, fine surface, suitable for the proper sowing

of the seed by means of hand drills. The tools generally employed for this purpose are the plow, disk harrow, roller, smoothing harrow, and sometimes a pull or drag made of scantlings or planks. A harrow of the type shown in figure 3 is adapted to the final preparation before planting.

On some land onion sets have been grown continuously year after year without any appreciably injurious results. In other localities it has been found necessary to adopt a crop-rotation system, and this is advisable wherever the quantity of available land is sufficient. A rotation including corn, Irish potatoes, onion sets, and clover will be found quite satisfactory.

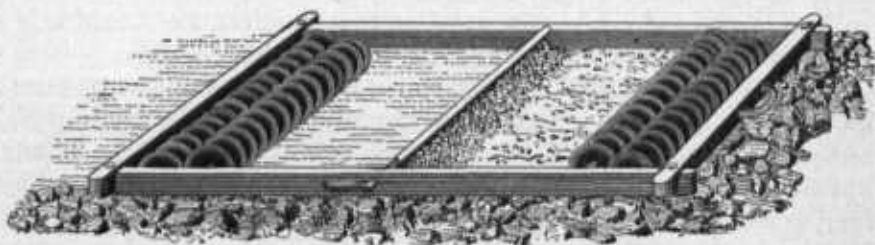


FIG. 3.—Harrow for leveling soil for planting seed.

FERTILIZERS.

In preparing the land for growing onion sets large quantities of barnyard manure should not be applied immediately before planting. If barnyard manure is to be employed it should be used the previous season on some other crop in order that it may become fully incorporated with the soil and in a measure subdued. Commercial fertilizers may be employed profitably in moderate quantities, say 600 to 1,200 pounds to the acre, and should be broadcasted at the time of fitting the land. This fertilizer should contain about 4 or 5 per cent of nitrogen, 6 or 8 per cent of available phosphoric acid, and 8 or 10 per cent of potash.

SOWING THE SEED.

As the essential feature of growing onion sets is the crowding together of the plants in the rows, a large quantity of seed is required to plant an acre. The quantity of seed required varies with the different localities. In the vicinity of Louisville, Ky., from 55 to 60 pounds to the acre are sown; Chillicothe, Ohio, 40 to 50 pounds; Chicago, 55 to 120 pounds; while in New Jersey as low as 25 pounds to the acre are used.

The drills employed for seeding are, as a rule, the hand seeders usually found upon the market used for sowing seed of all small

truck crops. In some localities, however, special seeders have been designed in order to distribute the seed in a particular manner. Near Chillicothe, Ohio, many of the growers employ a drill having five small teeth similar to the shoes of an ordinary grain drill, but on a very small scale. (See fig. 4.)

These seeders distribute the seed in five little drills about an inch apart, making a broad belt of five rows. Another method is to place a funnel-shaped spreader on the under part of the drill, which scatters the seed over an area of 3 or 4 inches in width.

DISTANCES TO PLANT AND QUANTITY OF SEED REQUIRED.

The distance between the rows ranges from 7 to 14 inches, but varies with the method of sowing. The larger yields are obtained

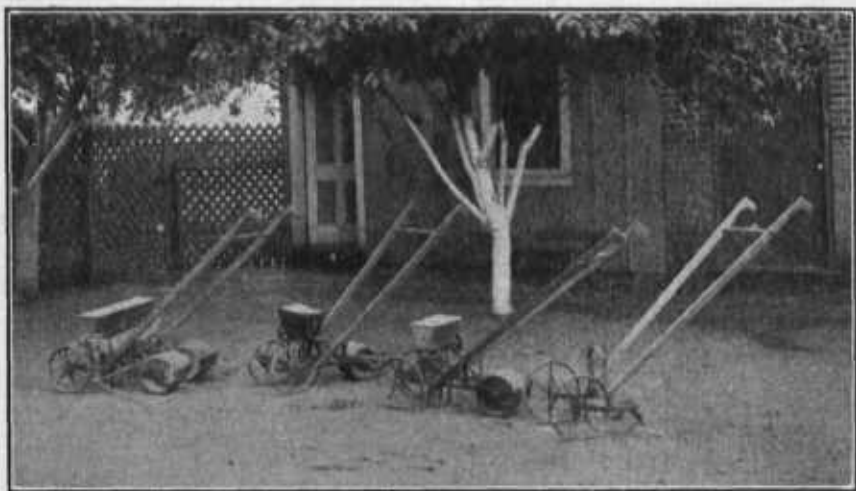


FIG. 4.—Special tools for planting and cultivating onion sets.

by sowing in single drills about 9 inches between the rows and using 65 to 85 pounds of seed to the acre. The majority of growers endeavor to sow their onion seed as early as the land can be put in first-class condition. Formerly the seeds for sets were not sown until late in the season, but it has been found that larger yields of sets can be obtained and that the sets will ripen better if the seed is sown early.

The New Jersey growers have found it more profitable to grow a sort of mixed crop, including all sizes from sets to marketable onions. A smaller quantity of seed is employed per acre, but, on the other hand, the method of growing is somewhat different, and a larger percentage of overgrown bulbs is secured. Those that are below standard size are sold as "boilers" or "stewers," "pieklers," and "sets."

By using about 25 pounds of first-class seed to the acre and planting in rows 24 inches apart these growers are enabled to employ horse culture, and succeed in growing about 300 bushels of all sizes to the acre. This method of planting does not greatly decrease the yield and at the same time reduces the cost of cultivation.

CULTIVATION.

As a rule onion seed will germinate and the plants appear above ground so that the rows can be followed within six or eight days after planting. It is desirable that the soil should be stirred frequently and that the weeds should never be given an opportunity to gain a foothold. The onion sets should be cultivated at least once every week during their growing period, and oftener if rains occur.

The tools employed are for the most part of the wheel-hoe type, of which there are a number of forms. These tools are provided with numerous attachments for cutting close to the plants, for throw-

ing the soil away from the rows, and for leveling and working it back around them. One or two of the Chicago growers have adopted a special wheel hoe of their own design, using the front wheel of a

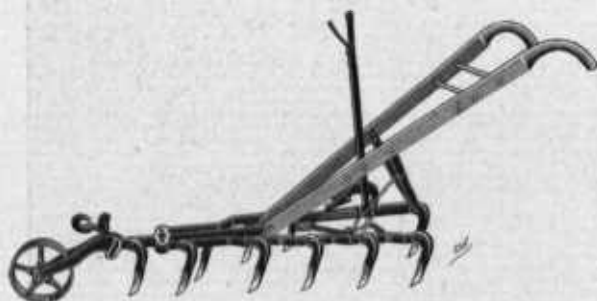


FIG. 5.—One-horse cultivator of the harrow type.

bicycle and a pair of light-weight plow handles for the frame, to which the various types of sweeps and shovels are attached. In New Jersey horse tools are employed almost exclusively, the 14 or 15 tooth harrow-type cultivator (fig. 5) being the favorite.

Hand weeding seems to be an essential in all localities, although this laborious process can be eliminated to some extent by proper wheel-hoe and horse cultivation. The cost of hand weeding and care of the onion-set crop may be anywhere from \$10 to \$50 an acre for the season. The entire cost of the cultivation of an acre of onion sets during the season should not exceed \$50, and this may be reduced 50 per cent if the land is in proper condition and the work is handled at the right time. Hand weeding in most cases will be necessary twice during the growth of the crop. During rainy seasons it is often found impossible to keep certain areas clean, and when the weeds once become well established there is very little hope of saving the crop. When the sets have attained considerable growth the tops shade the ground and prevent, in a measure, the

growth of weeds. After this stage has been reached very little attention will be required. In fact, the stirring of the soil should



FIG. 6.—Hand weeding an onion-set field during early summer.



FIG. 7.—Harvesting onion sets near Louisville, Ky.

cease before the sets show any tendency to ripen. Figure 6 will give some idea of the appearance of an onion-set field at the period of its maximum development.

HARVESTING AND CURING.

The time for harvesting is just when the sets begin to ripen. This generally occurs about July 4 in southern localities, and July 20

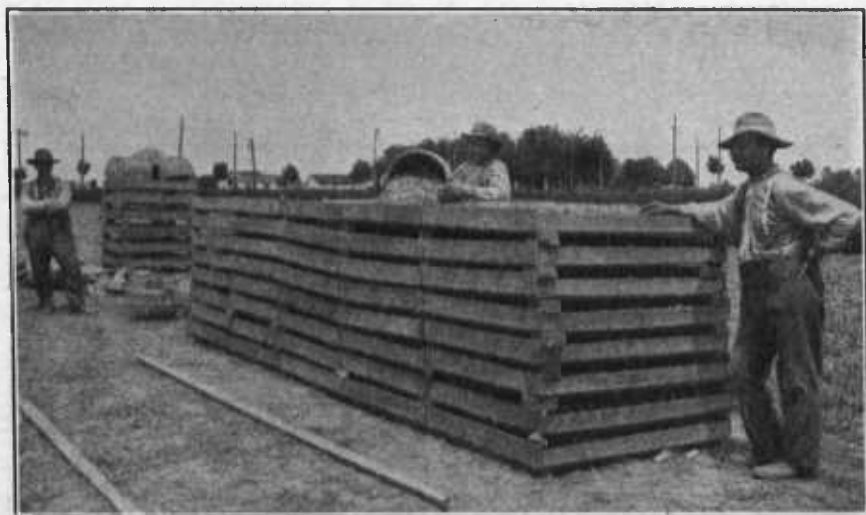


FIG. 8.—Onion sets drying on trays piled in a field.



FIG. 9.—“Stacking” onion sets to cure in a field.

near Chicago, or from 90 to 110 days from the date of sowing the seed. The methods of harvesting are different in the several localities. Near Louisville, Ky., the sets are allowed to become quite ripe before harvesting.

At harvest time, the sets are loosened from the soil by means of a cutter attached to a wheel hoe or with broad forks having 10 or 12 tines. They are then pulled by hand, as shown in figure 7, the tops twisted off by hand, and the bulbs sifted and placed upon trays to dry. These trays are piled one upon another in the field (fig. 8) with a space of 3 or 4 inches between and a temporary roof placed over them. They are allowed to remain upon these trays until quite dry and are again screened and removed to the storehouse.

Near Chillicothe, Ohio, the sets are pulled while yet quite green and stacked in the field in long narrow ridges (figs. 9 and 10), the bulbs being placed underneath so that the tops will protect them from sunlight and rain. After remaining in these ridges about two weeks,



FIG. 10.—Onion sets curing in "stacks."

the tops are twisted off and the bulbs placed upon screens to dry. From the screens they are hauled to the warehouse where the fanning and cleaning take place.

Near Chicago, the practice of pulling is very similar to that in the vicinity of Louisville, the tops being twisted off as the sets are removed from the soil. In New Jersey the sets are allowed to become fully ripe before being removed from the soil and are harvested and cured together with the larger bulbs, after which they are separated by screening and fanning.

After pulling it is essential that the sets be subjected to a drying process; during this process they require plenty of ventilation. This

can be most easily secured by spreading the sets on trays, commonly called crates, that are provided with corner pieces extending 4 or 5 inches above the sides of the trays. As a rule these trays are constructed with 3-inch sides, about 5 feet square, with slat or wire bottoms, and hold about 3 bushels of onion sets. When the trays are piled one upon another the corner pieces provide an air space above each tray, thus securing the best possible ventilation. In the absence of corner pieces blocks of wood or broken bricks are employed, as shown in figure 8.

STORING ONION SETS.

The method of storage is essentially the same in all localities, the tray previously described being most commonly used (fig. 11). When



FIG. 11.—Onion sets stored on trays in a warehouse.

the sets have become sufficiently dry some growers transfer them to 1-bushel crates, in which they are shipped. Onion sets are stored under conditions similar to those required for large onions, the essentials being plenty of ventilation, dryness, and a comparatively low temperature. Slight freezing will not destroy them, provided they are not disturbed while frozen. However, freezing is always injurious and has a tendency to cause them to sprout earlier in the spring. If a uniform temperature 2 or 3 degrees above freezing can be maintained it is more satisfactory than too frequent variation.

Some growers employ a form of open shed as a temporary storage place for the sets during the autumn months or until cold weather

begins. A few growers store their crop until late winter and sell direct to seedsmen and dealers, but the majority turn their sets over to warehousemen for storage and disposal. Throughout the storage period the sets should be handled as little as possible and should be kept spread out thinly, so there will be no chance of heating. Onions in storage are constantly giving off more or less moisture and are liable to become damp and sprout if stored in too great bulk.

In preparing the sets for market they are first passed through a fanning mill which removes all loose skins, earth, or shriveled bulbs, and then over a screen which removes any bulbs that are too large for the market demands. After this they are shipped in 1-bushel crates, burlap bags, or barrels.

The crate is perhaps most desirable as a shipping package, as it protects the bulbs and allows a free circulation of the air. When

shipped in bags, the sets are liable to become injured, except where they are handled in earload lots. Tight barrels are objectionable unless the sets are thoroughly cured, as there is liability to heat in the center.

PROPER SIZE OF ONION SETS.

The ideal onion set is almost globular in shape and a trifle less than half an inch in diameter.



FIG. 12.—A quart of almost ideal onion sets.

Figure 12 shows a quart of first-class onion sets. The color should be bright and the surface free from smut or spots of any kind. The term "pickler" is applied to the onion just above sets in size, or, in other words, one-half to three-fourths of an inch in diameter. The term "boiler," or "stewer," is applied to the size next larger than picklers, which are too small for sale as standard onions, or from three-fourths of an inch to $1\frac{1}{4}$ inches in diameter.

Another type of bulblet sometimes sold for propagation is that of the "top" or "tree" onion. These bulblets are formed on the top of a stalk similar to a flower stalk, and if planted will produce a

fair-sized bulb. If the bulbs are allowed to remain in the soil they will throw up stalks the following season and produce bulblets for further planting. This variety is extensively used for the production of young onions which are peeled, bunched, and marketed during the early spring. The bulblets are planted closely, either in beds or in rows, during the late autumn, and the young onions will be ready for use early in the spring. In cold climates slight protection will be required in order to carry the planted bulbs safely through the winter.

VARIETIES OF ONIONS USED FOR SETS.

Seed of almost any variety of onion may be used for the production of sets, but a greater demand exists for the distinctly yellow, white, and red colors. In the trade the sets are recognized by their color rather than by actual varietal names. The demand for the yellow and the white sets is greater than for the red, and those of the globular type are generally preferred.

Onion sets are sometimes grown from left-over seed, in which case a large number of varieties may be included. In the principal set-growing districts, where the seed has been locally grown for many years, the varieties are more or less distinct from those of seedsmen's catalogues.

ENEMIES OF THE ONION.

FUNGIOUS DISEASES AND INSECT PESTS.

The onion crop of the United States is by no means free from both disease and insect enemies. Some of the enemies of the onion may be controlled without much difficulty, while others, if once established, can not be eradicated by any means known at present.

Onion Smut.

The following paragraphs are extracted from a recent bulletin issued by the Ohio Agricultural Experiment Station:

Onion smut (*Urocystis cepulae* Frost), unlike the other smuts with which we have to do, propagates itself almost indefinitely in the soil when this once becomes infested. Whenever a new crop of onions is grown from seed in this infested soil the smut attacks the young seedling onions, in whole or in part, and a very considerable loss results therefrom. If, however, onion sets are put in such soil or seedling onions that have been started under glass in healthy soil are transplanted to smut-infested soil, the smut fungus can not attack them. The explanation seems to be that the smut threads are only able to penetrate the leaves of the young, tender seedlings. Flowers of sulphur have been used to sow with the seed in infested soil, and this remedy has given but slightly inferior results to any other yet tried.

The best method has proved to be that of formaldehyde drip with seeder. The formaldehyde solution is made at the rate of 1 pound of 40 per cent formaldehyde to 25 to 33 gallons of water. This is applied with drip attachment on seed drill at rate of 125 to 150 gallons per acre for field onions. The same results can be obtained in open furrows by applying solution with sprinkler after seeds are scattered until well moistened. This formalin treatment insures the disinfection of a layer of soil near the seed and permits the germination and the early growth of the seedling onion past infection stage before the smut fungus can again occupy this soil. The gains from this treatment, both in the onion-set work and in field onions are very large, amounting to 100 to 200 per cent increase.¹

The Maggot.

The onion maggot is often very destructive in fields that are just planted. This insect works at the roots of the young seedlings and is difficult to control.

The following methods of control have been suggested:

Carbolic-acid emulsion.—For all three forms of root maggots which we are considering, a carbolized form of kerosene emulsion is effective. This is prepared by adding to 1 pound of soap boiled in 1 gallon of water one-half gallon of crude carbolic acid and diluting the whole with from 35 to 50 parts of water. This mixture is applied about the stalks of the plants affected. It is best to use it a day or two after the plants are up or are transplanted, and repeat every week or 10 days until about the third week in May in the North. Farther south these applications must be made earlier in the season.

The use of mineral fertilizers.—Mineral fertilizers are useful as deterrents, particularly when employed just before or after a shower has thoroughly wet the ground. The principal fertilizers for this purpose are kainit, nitrate of soda, and sulphate or chloride of potash. They may be used as top dressings before planting, or, if not employed until afterwards, they should be applied as nearly as possible to the roots, the earth being turned away from the plants for this purpose. These fertilizers possess the advantage of acting also as a stimulant to plant growth, thereby facilitating recuperation from root-maggot attack.

Danger from use of organic fertilizers.—Stable manure and organic fertilizers are apt to induce infestation, since the species under consideration is well known to develop in excrement and other decomposing material. Numerous instances of this have come to the writer's knowledge during recent years. It is advisable, therefore, to avoid the use of manure, rotted leaves, or other organic fertilizers, and to avoid planting in fields in which there have been infested or diseased plants.²

The Thrips.

The onion thrips belongs to the class of sucking insects, attacking the leaves and causing them first to assume a dull-gray or dirty appearance and afterwards to turn brown and die. This insect has proved very destructive, especially throughout the Southern States,

¹ Ohio Agricultural Experiment Station Bulletin No. 214.

² Circular No. 63, Bureau of Entomology, U. S. Dept. of Agriculture.

and is now becoming quite a serious pest in the Bermuda-onion district of Texas. It is noticeable that insects of this character generally attack crops that are grown upon poor soils, that are late planted, and where the cultivation is neglected.

The remedies to be employed for the onion thrips are varied. Kerosene emulsion is of less value than for many other sucking insects; whale-oil soap is one of the standard remedies, and some of the tobacco or nicotine preparations have recently been found useful.

CONCLUSIONS.

There is nothing difficult in the production of either onion sets or seed and one or both may be undertaken as a side issue with other lines of farming. The work of earing for the crops may be done largely by women and children where it is desirable to provide work of this nature for them.

No large profit can be obtained from the production of either onion seed or sets, and the greater profits are obtainable from comparatively small plantings. On a considerable portion of the land devoted to onion-set raising the yield is less than 300 bushels to the acre. Allowing for the cost of seed, fertilizers, cultivation, harvesting, and handling, the net returns are not large, especially when sets bring only 50 or 60 cents a bushel.

The method of growing white onion sets followed by the New Jersey growers seems to be the most profitable, as the sets are simply a by-product of the onion crop, the main object being to secure a large yield of small, white onions, known as "picklers," which bring a high price in most of our markets.

[A list giving the titles of all Farmers' Bulletins available for distribution will be sent free upon application to a Member of Congress or the Secretary of Agriculture.]